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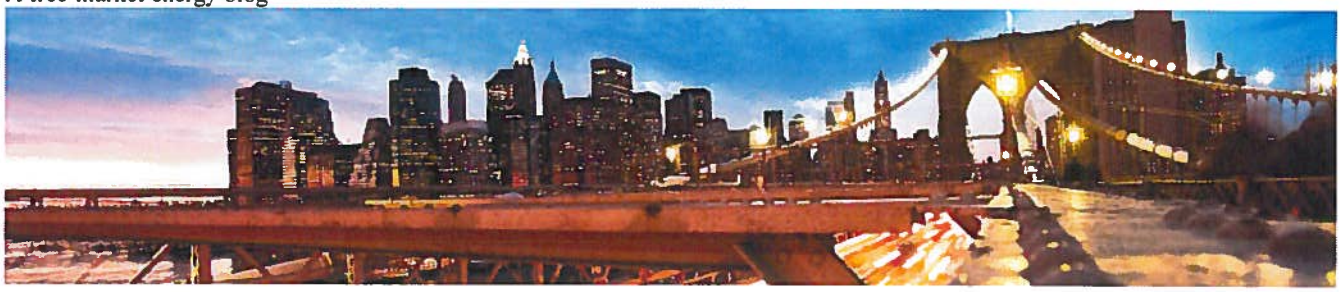

Power Hungry: The Myths of "Green" Energy and the Real Fuels of the Future—by Robert Bryce (nutrition for energy appetites)

by Jon Boone
April 27, 2010

[Editor note: Bryce's Power Hungry, released today, is his second book on energy after Gusher of Lies and fourth book overall.]

In his brand new book *Power Hungry*, energy journalist and Austin apiarist Robert Bryce marshals many numbers to plainly show how modern culture exacts power from energy to save time, increase wealth, and raise standards of living. Bryce also dispenses common sense to citizens and policy makers for an improved environment, a more productive economy, and a more enlightened civil society.

Inspired by enegy writings of Rockefeller University's Jesse Ausubel, and the University of Manitoba's prolific Vaclav Smil, he makes the case for continuing down the path of de-carbonizing our machine fuels—a process begun two hundred years ago when we turned from wood to fossil fuels and huge reservoirs of impounded water. As the world's population continues to urbanize, people will inevitably demand cleaner, healthier, environmentally sensitive energy choices.

Today, the world uses fossil fuels (oil, gas, and coal) for approximately 86 percent of its energy, getting a lot of bang for its buck. Bryce offers convincing evidence that, over the next several generations, particularly since broad energy transformations require much time and financial investment, relatively cleaner burning natural gas will provide a bridge to pervasive use of nuclear power—"the only always-on, no-carbon source that can replace significant amounts of coal in our electricity generation portfolio." And if nuclear ultimately becomes the centerpiece for the electricity sector, which constitutes about 40 percent of our total energy use, this development would accelerate the de-carbonization of the transportation and heating sectors as well.

His narrative transcends the current climate change debate. He thinks the evidence on either side is equivocal, at best provisional, and, even if it could be proven conclusively that humans were responsible for precipitously warming the earth by producing a surfeit of carbon dioxide, there is little that could be done about the situation now that would be consequential or practical, except embrace imaginative adaptation approaches.

Four "Imperatives"

Bryce organizes his ideas around four interrelated "Imperatives" that serve as a prime motif for human history and explain much contemporary circumstance: power density, energy density, scale and cost. He shows that, although energy is the ability to do work, what people really crave is the ability to control the rate at which work gets done—power. Performing work faster means more time to do something else. This begets an appetitive feedback loop, where more power unleashes more time to produce more power. As the scale of this process increases, costs are reduced, making what power creates more affordable.

In terms of economic efficiency and improved ecosystems, producing the most power in the smallest space at a scale affordable by all is what present and future enterprise should ensure.

The power density of fossil fuels, expressed in watts, BTUs, or horsepower, has been the lynchpin of our modernity, although they will eventually become depleted, perhaps over a few centuries or much sooner, as various peak oil and coal scenarios suggest. (Bryce

shows that worldwide oil's market share has fallen over the last 35 years and the rate of decline will likely continue.) And they do have negative environmental consequences.

Particularly coal, with such environmentally treacherous extraction techniques as strip mining/mountaintop removal, and toxic emissions. But their overall benefits at present outweigh the negatives in a comprehensive cost benefit analysis. Which is why they're so popular.

Hydrocarbons lift people out of poverty, literally empowering them to better health, wealth, and productivity. "The key attribute of hydrocarbons is their reliability," a precondition for coordinated economic and social convergence, which is the very hallmark of modern life. Planning to replace their capacity successfully will demand great ingenuity and the most advanced technology—not hyped-up premodern gadgetry like industrial wind technology.

Energy Appetites

Over the first seven chapters of his book, Bryce lays out the gargantuan scale of our energy consumption, bound on the one side by the existence of nearly seven billion people and the thirst for increasingly denser power supplies on the other. He shows why, if oil didn't exist, we'd have to invent it. Deploying helpful charts and graphs throughout, he demonstrates that we will not, indeed cannot, quit using hydrocarbons any time soon, since our daily consumption is equivalent to 226 million barrels of oil, equal to the total daily output of twenty-seven Saudi Arabias.

The world consumes nearly 7 billion horsepower a day, albeit unevenly, since Americans consume energy at 18 times the rate of people in Pakistan and India. America leads the world in reliable horsepower and produces about 74 percent of the primary energy it consumes. Moreover, it has more hydrocarbon reserves than any other nation. Yet, despite (or, perhaps, because of) all this power, the United States leads the world in energy efficiency and per capital carbon emission reductions over the last fifteen years.

Myths of Green Energy

So why are so many willing to trade the high power-density of coal, natural gas, and oil for such unreliable, low power-density sources as wind and solar?

Part II, The Myths of Green Energy, attempts to answer this question. Bryce looks closely at the claims for wind especially and debunks them all as mainly the result of snake oil, a too-gullible public suffused in scientific illiteracy, "happy talk" from media (viz, Thomas Friedman), and self serving bombast from industry pundits like T. Boone Pickens. Thinking that wind technology, for example, could put a dent in the use of fossil fuels as an "alternate" energy source is just plain goofy, akin to believing that a book of matches could melt a glacier. Believing that corn and cellulosic ethanol are friends of the environment and consumers is downright Orwellian. In truth, they reduce efficiency and performance while damaging machine engines, and raise the cost of food by shrinking food supply while depleting millions of acres of soil and siphoning off a sea of water. For shame.

Bryce reinforces the theme of his previous book, *Gusher of Lies*. The energy business is so vast and intricately global that it dooms any nation's quest for energy independence. Those who think more hybrid cars, wind machines, and solar cells will free the United States from its dependence on imports will be shocked to discover that those technologies hinge on rare earth elements obtainable almost exclusively in China. Which fact largely explains why the Chinese are rapidly becoming a dominant manufacturer and exporter of "green" technologies.

Challenging Flimflam

Bryce relishes challenging flimflam. *Power Hungry* demolishes the notion that oil is dirty; that carbon capture/sequestration schemes can be globally effective; that cap-and-trade/taxation/renewable energy credit ideas for reducing carbon dioxide emissions can do anything but worsen the situation at the expense of tax and ratepayers; that plug-in electric cars will soon revolutionize the transportation sector; and that efficiency, desirable as it is as a means of conservation, can change the world.

Bryce's conclusions about better policy follow the logic of Sherlock Holmes: "When you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth." By eliminating the imposters and exposing the disingenuous, he is then able to engage in rational discourse about the genuinely probable technologies that will in future slake our vast craving for power.

He states the problem in a way that suggests solutions. If society seeks cleaner air and water, if consumers seek cheaper energy, if environmentalists seek open vistas and large swaths of untrammeled nature, if politicians seek a significant reduction of greenhouse gasses while meeting the expanding power requirements of modernity—then the future of energy conversion for electricity must hinge on increased use of natural gas in the near term while the world prepares for nuclear power over the long haul. Given the magnitude of the situation, anything else is hope. And prayer.

Recounting the sorry recent history of natural gas supply, Bryce explains how pandering politicians and the coal industry combined to reduce its availability, making the public think the resource had been exhausted. However, new discoveries of extensive shale deposits in the United States, along with improvements in extraction technologies, now make natural gas much more available. That it burns 50 percent cleaner than coal, emits no toxic particulates, and is so versatile, make it the ideal transitional fossil fuel for the

next generation or so. As more supplies become available, costs will continue to drop, making natural gas more appealing to consumers. To protect against damaging the ground water and pollutant leakage through gas lines, the industry would have to be carefully regulated, particularly in remote areas during the extraction process.

Looking for Mr. Green

Still, as good as they are, carbon-based fuels, even those as beneficial as oil and natural gas, continue to put us at odds with our potential for informed stewardship of the planet. Our best scientists tell us we must do better in achieving goals of sustainable biodiversity and healthier ecosystems. To do so, we should sooner than later move beyond sloganeering and heavy reliance on fossil fuels.

As Bryce says, "nuclear goes beyond green." It provides two million times the power density of fossil fuels and can be contained in a small area, preserving the countryside. Concerns about its safety because of exaggerated news accounts of the damage inflicted by the Three Mile Island/Chernobyl accidents, along with the dramaturgy wrought by Hollywood, have allowed fear mongering to prevail over sound science. Despite not building a single nuclear plant in thirty years, the US still has more nuclear facilities than any nation in the world. US nuclear plants have a capacity factor of 92 percent, significantly better than any other generating system. Even though nuclear has only 11 percent of the nation's installed capacity, it nonetheless satisfies 20 percent of demand.

The PJM grid (the nation's largest, with 51 million customers) uses nuclear for 35 percent of its generation, and has done so safely for over twenty years.

For the last thirty years, France has employed nuclear for 80 percent of its electricity consumption. The French reprocess most of the spent fuel, capturing the uranium and other materials so that they can be sent through the reactors again, reducing "the volume of waste by a factor of two or three." Moreover, Bryce highlights the prospects for a fusion-fission transmutation system in the near future that would create additional fuel for electricity and medical applications. It would also substantially reduce radioactive half-life time—while preventing the proliferation of nuclear weapons.

The potential for newer, smaller, safer nuclear power plants is enormous, and *Power Hungry* explores a range of what is probable. Today, the capital costs of large nuclear plants are very high, but they can run continuously without interruption day and night year after year. Their long-term maintenance costs are relatively low. Compared with building a large hydro dam, however, which has enormous negative environmental consequences for entire watersheds, construction costs for nuclear are a bargain. Contrasted with the incredibly high capital costs of wind projects, which provide only sporadic energy and no modern power performance, nuclear is incomparable, for there is no apples-to-apples comparison to be made with wind. How can one compare the best performing car ever made with a clunker that never works as desired?

Taking on Renewables

Bryce brings his narrative sweep to a conclusion by calling for rethinking what the notion of green should mean. In particular, he urges that environmentalism return to the days when those commanding the movement revered hard facts, treasured good science, and understood that culture was part of nature, not mystically outside of it. They knew the "hard truth" that "energy production is not pretty, cheap, or easy." Although they may have been initially seduced by the allure of "renewable energy," they would have finally understood that the whole concept of renewables is problematic, since nothing is continually renewable; they only appear that way from the short perspective of human time.

As many have discovered about the only widely effective renewable, impounded hydro, simply because a source of power is clean-burning does not make it "green." Informed environmentalists should know that the current push for wind technology is based on the *mistaken* belief that wind is greener than hydrocarbons such as oil and natural gas.

Power Hungry also urges renewed support for the International Atomic Energy Agency; putting the skids on the ethanol boondoggle by short-circuiting Iowa's stranglehold on presidential primaries; pushing for greater scientific/engineering literacy and less political grandstanding in public policy; banning mountaintop removal coal extraction techniques; and imposing coordinated reality on national energy policy. The policy goal should be to promote "cheap abundant energy" consistent with the protection of sensitive habitat, vulnerable species of flora and fauna, and a more diverse and empowered planet.

Wind Scam

The book covers so much ground across so many topics that it is unfair to quibble about details that are not fully accounted for. Bryce gets the important ideas right. He spends much time trimming the sails of the industrial wind fandango, in part because he knows it is inconsequential as an energy source but also because public dollars invested in it represent dollars not spent on effective power. He couldn't find a shred of empirical evidence that wind has been responsible for offsetting greenhouse gas emissions in the production of electricity—or that it has contributed to any reductions in fossil fuel use. Even in the wind poster nation of Denmark. Instead, he found only "projections" offered up by industry trade organizations or government agencies beholden to wind success that were uncontaminated by reality—much like college football polls.

Most importantly, he tells why wind can't offset meaningful CO2 emissions or replace fossil fuels. To do this, he introduces the work of engineers like Australian Peter Lang, Canadian Kent Hawkins, and Britain's Jim Oswald, who demonstrate how wind's existential

volatility and unreliability must make everyone and everything involved with wind integration work much harder just to stand still—greatly increasing both cost and thermal activity in the process. Wind is a fuel supplement that itself requires a lot of supplementation, since no one can be sure how much of its capacity will be available at any future time. A wind plant's output unpredictably bounces around between zero and its maximum possible yield.

The challenge is how to reconcile the square peg of firm reliability with the round hole of wind's fluttering caprice. Since it must match supply perfectly with demand at all times, no grid can allow wind volatility to be loosed by itself; it must be entangled with proactive, highly dynamic conventional generation to make its capacity whole. More than 70 percent of any wind project's maximum capability must come from reliable, flexible conventional generation, typically natural gas units working inefficiently to do so. These inefficiencies accumulate quickly, eventually consuming more fuel in the same way that an automobile does in stop-and-go traffic.

As Lang shows, even the *best possible* thermal entanglement with wind, comprised of several types of natural gas systems, can save only 15 percent more CO2 than can be achieved with the natural gas systems alone, without any wind. Inefficient use of natural gas systems with wind, such as responsive open cycle units normally used only at peak demand, would save no net carbon dioxide emissions. As Hawkins shows, using a combination of coal and natural gas for wind balancing results in *more* carbon emissions than would be the case without any wind. Any fossil fuel saved when it is sporadically displaced by wind is often consumed in even greater volume as it is called upon to compensate for wind's relentless skittering.

More than 2500 skyscraper-sized wind turbines, spread over 500 miles of terrain, and a passel of natural gas units at 90 percent of wind's maximum output—and hundreds of miles of new transmission lines/voltage regulation—would be required to provide parity with the capacity of a single 1500MW nuclear facility.

Bruce makes vividly clear that wind is neither clean nor green—and is in the hunt solely because of massive government support, which is 23 times the per kilowatt-hour subsidy given for fossil-fired plants that produce copious reliable capacity. It provides only sporadic energy—not modern power performance. Wind is not only inimical to all the primary goals of modern electricity production—reliability, affordability, security; it also actively subverts them. It is not cutting edge, effective, and progressive; rather, it is antediluvian, dysfunctional, and uncivil.

In many ways, wind resembles the character Major Major Major Major, made so indelible by Joseph Heller in his immortal Catch-22. Like wind, even when the Major was in, he was out. Even more apropos is the connection with Major Major's father, a Calvinist alfalfa farmer who received a public subsidy for every acre of crop he did *not* grow, using the money to buy more land on which to *not* grow alfalfa. He thought such practice was divinely ordained, proclaiming, "You reap what you sow," while maintaining that federal aid to anyone but farmers was "creeping socialism." With only a few word changes, this is the line trumpeted by the American Wind Energy Association on behalf of its limited liability companies.

Spawned, then supported, by government welfare measures at considerable public expense, wind produces *no* meaningful product or service yet provides enormous profit to a few wealthy investors, primarily multinational energy companies in search of increased bottom lines through tax avoidance. Wind does reap what it sows, masquerading as a power source to hide its real identity as an Enronesque tax shelter generator.

Conclusion

Power Hungry sets the stage for an inquiry about why wind has become so politically attractive. Gullibility and dimwittery are surely part of the explanation, as Bryce suggests. But the real causes may have more to do with the nefarious acquiescence of our regulatory and government agencies—combined with how the power industry itself has embraced wind. Why aren't utilities in general, and regulatory agencies and grid controllers in particular, being held accountable for what they're doing to ratepayers by supporting generation that must destabilize the electricity supply/transmission system? To what extent are corporations that are heavily involved with coal, natural gas, and oil also involved with wind? The bipartisan dive to the bottom now enabling the wind scam is worthy of another book.

As it is, *Power Hungry* provides a grand tour of our energy landscape in the best journalistic tradition of serving the public good, exposing the cant of received wisdom and using the authority and weight of good numbers to put ideas into proper perspective. Bryce's numbers provide giant shoulders upon which to stand, allowing us to see farther and better, increasing our knowledge and improving the odds for institutional wisdom. There are few things more important to the world's life, liberty, and happiness than an enhanced ability to convert abundant energy into high power at affordable cost. Robert Bryce, with buoyant bonhomie, marks the way.

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Let's Coordinate Policy

Thomas F. Farrell II is chairman, president and chief executive officer of power company ***Dominion Resources Inc.***

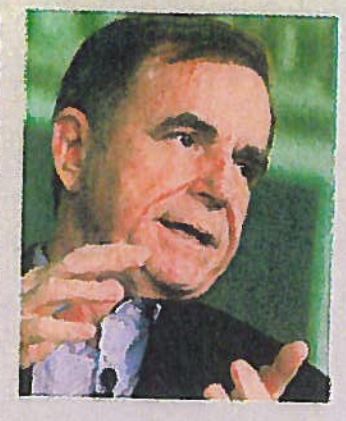
◆ ON THE NEED FOR A COMPREHENSIVE ENERGY POLICY: Let's at least coordinate the policies across the federal government by putting in place an energy adviser that is at the same level as the national security adviser and the national economic adviser to the president.

Every agency of the government has its own energy policy. The Navy is talking about covering Ford Field, where the Japanese bombed at Pearl Harbor, with a solar array. The Army is looking at different things. The Air Force is using biofuels in its planes. And then you go to what the Department of Energy's doing, what FERC is doing, the EPA is doing, the Nuclear Regulatory Commission is doing. They're all doing their own things.

Having a group of people sitting down, thinking through all of this—what's available, what demands are, what sources we have, where does nuclear fit into this, where do climate policies fit into this—nobody does that.

◆ ON THE POWER MIX IN THE NEXT 10 YEARS: You're going to see a lot more natural gas over the next decade. We're shutting some coal plants and building gas to replace them. Longer term, we're looking at building another nuclear plant in Virginia. It would be in a regulated market. I don't think you're going to see a nuclear plant built in a deregulated market, because you need a monopoly infrastructure to be able to make sure you're going to recover those costs.

But long term, I think it's foolhardy to just build natural-gas power plants. They use a lot of power. You want to see the price of natural gas rise significantly over the years, replace all coal, all nuclear over the next 20 or 30 years with natural gas. You're going to regret it.

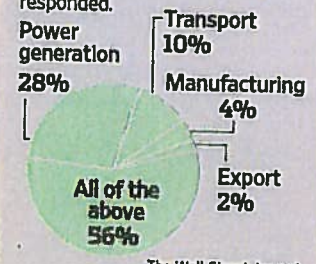


Renewables can thrive in certain geographies. Big solar arrays work great in the Southwest. They don't work in the mid-Atlantic. Wind works very well in the upper Midwest, Texas. It doesn't work well in the mid-Atlantic. But in the upper Midwest, lots of wind comes on the grid. And nuclear plants need to run all the time. So the economics of them are challenged in that environment.

We need renewables, efficiency. We need a lot more nuclear, because if you're serious about carbon reductions, you need to be serious about building more nuclear power plants.

Putting It to Work

What should the U.S. use its natural-gas bonanza for? Here's how ECOnomics participants responded.



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